Chapter 8: Implementation of the Long-Term Plan for Achieving Water Quality Goals in the Everglades Protection Area

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SUMMARY

This chapter presents an update on the progress of the implementation of the Long-Term Plan for Achieving Water Quality Goals in the Everglades Protection Area (Long-Term Plan) (Burns and McDonnell, 2003). Because there is overlap between many of Long-Term Plan projects and other District Everglades restoration efforts, the updates for many of the Long-Term Plan projects will appear in other chapters of the *2005 South Florida Environmental Report – Volume I.* For example, the Long-Term Plan projects that cover the Everglades Stormwater Program (ESP) basins and source controls will be covered in Chapter 3 of this volume, and the LTP projects relating to the Everglades Construction Project (ECP) Stormwater Treatment Areas (STAs) will be covered in Chapter 4 of this volume. For additional reference, **Table 8-1** indicates the chapter where each LTP project update appears.

The long-term Everglades water quality goal is for all discharges to the Everglades Protection Area (EPA) to achieve and maintain water quality standards in the EPA, including compliance with the phosphorus criterion established in Rule 62-302.540, Florida Administrative Code (F.A.C.). Substantial progress towards reducing phosphorus levels discharged into the EPA has been made by the State of Florida and other stakeholders. Since the end of April 2004, the Everglades Agricultural Area's (EAA's) Best Management Practices and the Stormwater Treatment Areas have removed over 1,730 metric tons of phosphorus that otherwise would have entered the Everglades. This is approximately an additional 230 metric tons of phosphorus removed since the end of April 2003. Nonetheless, additional measures are necessary to achieve the Everglades water quality goal. The Long-Term Plan contains activities to achieve that goal and to permit the State of Florida and the South Florida Water Management District (District or SFWMD) to fulfill their obligations under both the Everglades Forever Act (EFA) [Section 373.4592, Florida Statutes (F.S.)] and the federal Settlement Agreement (Case No. 88-1886-CIV-MORENO). A summary listing and locations of the basins addressed in the Long-Term Plan are presented in **Table 8-2** and **Figure 8-1**, respectively.

The District began implementation of the Long-Term Plan projects in Fiscal Year 2004 (FY2004). The Long-Term Plan was submitted to Florida Department of Environmental Protection (FDEP) in December 2003 as part of the long-term permit application required by the EFA. The first annual public meeting for the Long-Term Plan was held on February 26, 2004 at the District's headquarters in West Palm Beach, Florida. The District's first request for a minor revision to the Long-Term Plan was approved by the FDEP on April 15, 2004.

Table 8-1. Summary of projects and reference chapters in the Long-Term Plan.

Project Code	Project Description	Chapter References in the 2005 SFER – Volume I
ECP BASINS		
Bc10	STA-1E Enhancements	4 (STA-1E section)
Bc20	STA-1W Enhancements	4 (STA-1W section)
Bc30	STA-2 Enhancements	4 (STA-2 section)
Bc40	STA-3/4 Enhancements	4 (STA-3/4 section)
Bc50	STA-5 Enhancements	4 (STA-5 section)
Bc60	STA-6 Enhancements	4 (STA-6 section)
Bf	ECP Operation and Maintenance - STAs and non-STAs	4 (each STA section)
Bf80	ECP Compliance Monitoring	4 (each STA section)
Bc05	ECP Operations Monitoring	4 (project-level activities section)
Bf81	STA Site Management	4 (each STA section)
ESP BASINS		
Bc75	Acme Basin B	3 (Section II)
Bc71	NSID	3 (Section II)
Bc72	NNRC Basin	3 (Section II)
Bc73	C-11 West Basin	3 (Section II)
Bc74	Feeder Canal Basin	3 (Section II)
PROCESS DEVELOPMENT AND ENGINEERING (PDE)		
Basin Source Controls		
Bc81(1)	EAA Basins - Source Controls	3 (Section I)
Bc81(2)	C-139 Basin - Source Controls	3 (Section I)
Enhanced Control and Monitoring		
Bc82(1)	Acquisition of Survey Data	4 (project-level activities section)
Bc82(2)	Additional Flow and Water Quality Monitoring Stations	4 (project-level activities section)
Bc82(3)	Review and Correction of Flow Measurement Anomalies	4 (project-level activities section)
Bc82(4)	Analysis and Interpretation	4 (project-level activities section)
Bc82(5)	Update and Maintenance of Hydraulic Models	4 (project-level activities section)
Improved Analytical and Forecasting Tools		
Bc83(1)	Continued Development and Refinement of DMSTA	8
Bc83(2)	Water Quality Impacts of Reservoirs	8
Bc83(3)	PSTA Investigations	4 (project-level activities section)
Bc83(4)	PSTA Demonstration Project in STA-3/4	4 (STA-3/4 section)
Optimizing SAV Performance		
Bc84(1)	Operational Strategy	4 (STA-2 section)
Bc84(2)	Vegetation Maintenance	4 (STA-2 section)
Bc84(3)	Hydrologic and Hydraulic Assessment	4 (STA-2 section)
Bc84(4)	Internal Measurements	4 (STA-2 section)
Bc84(5)	Comparative Analysis	4 (future reports)
Additional Structural and Operational Measures		
Bc25	Evaluation of Full-Scale STA Enhancements	4 (STA-1W section)
Improved Reliability of Inflow Forecasts		
Bc86(1)	Update Baseline Data Sets	8
Bc86(2)	Basins With Limited Current Data	8
Bc86(3)	Influence of CERP Projects on Inflow Volumes and Loads	8
Bc86(4)	Lake Okeechobee Long-term Trends	8
Bc86(5)	Determine Water Quality Relationships in the EPA	2C
ACCELERATE RECOVERY OF IMPACTED AREAS		
Bc87(1)	Recovery Model Development and Calibration	6
Bc87(2)	Downstream Influence of Adding Clean Water to Previously Impacted Areas	6
Bc87(3)	Options for Accelerating Recovery	6
Bc87(4)	Alternatives Analysis and Plan Formulation	6
Bc87(5)	Hydropattern Restoration	6
Bc87(6)	Implement Steps for Recovery in Impacted Areas	6
Bc88	**Adaptive Implementation**	8
Bc90	**Program Management**	8

Table 8-2. Everglades Protection Area (EPA) tributary basins included in the Long-Term Plan.

Basin	Canal	STA	Receiving Water
S-5A (EAA)	West Palm Beach Canal	STA-1W, STA-1E, STA-2	WCA-1
S-6 (EAA)	Hillsboro Canal	STA-2	WCA-2A
S-7 (EAA)	North New River Canal	STA-3/4	WCA-3A
S-8 (EAA)	Miami Canal	STA-3/4, STA-6	WCA-3A
C-51 West & L-8 Basin	C-51 West	STA-1E, STA-1W	WCA-1
C-139 (including Annex)	L-3 Canal	STA-5, STA-6	WCA-3A
ACME Basin B	N/A	N/A	WCA-1
North Springs Improvement District	N/A	N/A	WCA-2A
North New River Canal (G-123)	North New River Canal	N/A	WCA-3A
C-11 West	C-11 West	N/A	WCA-3A
Feeder Canal	L-28 Interceptor Canal	N/A	WCA-3A
L-28	L-28	N/A	WCA-3A

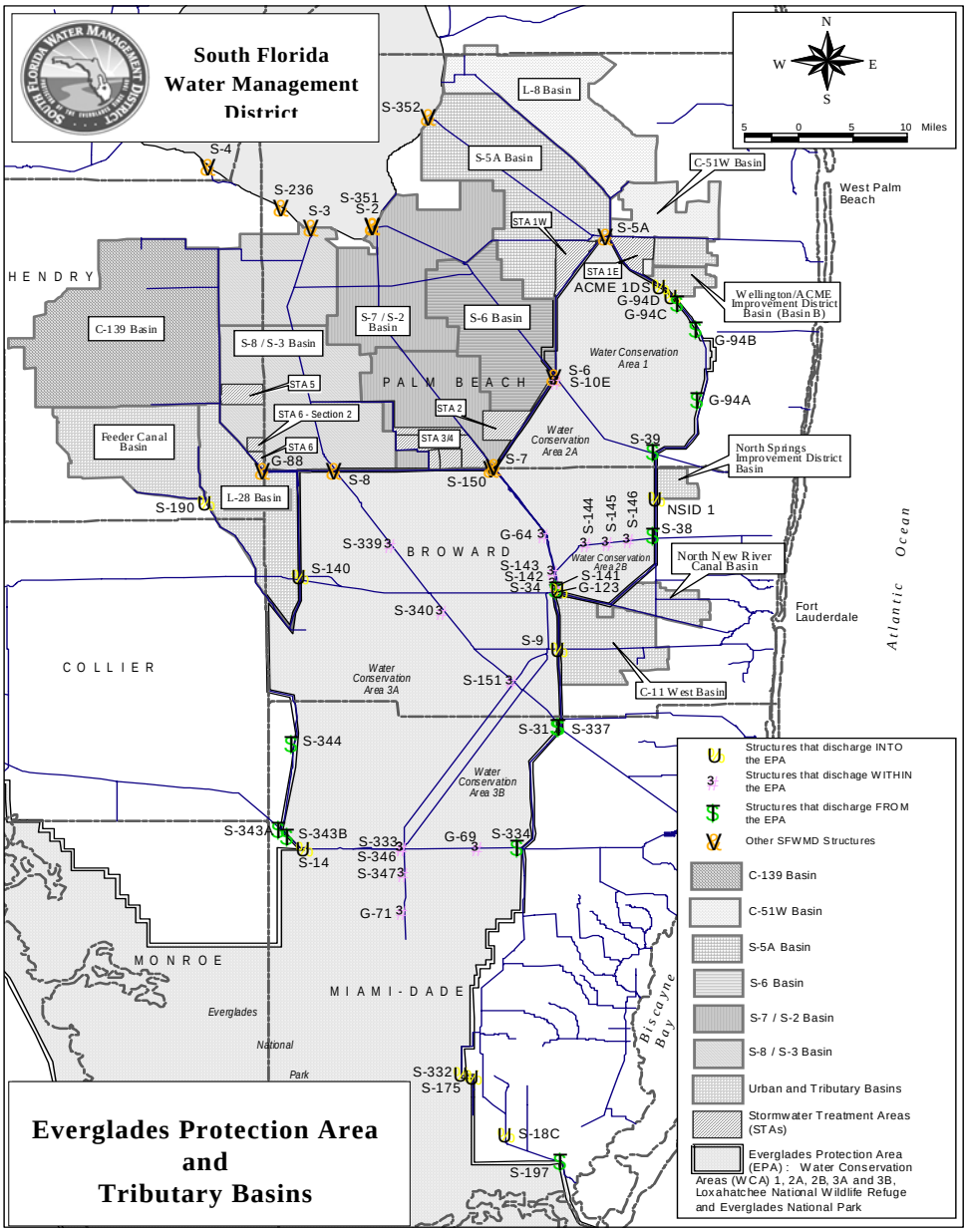

Figure 8-1. Overview of the EPA and tributary basins.

INTRODUCTION

The long-term Everglades water quality goal is for all discharges to the Everglades Protection Area (EPA) to achieve and maintain water quality standards in the EPA, including compliance with the phosphorus criterion established in Rule 62-302.540, Florida Administrative Code (F.A.C.). Substantial progress towards reducing phosphorus levels discharged into the EPA has been made by the State of Florida and other stakeholders. The combined performance of the source controls in the Everglades Agricultural Area (EAA) and the Stormwater Treatment Areas (STAs) of the Everglades Construction Project (ECP) has exceeded expectations. In addition, some source control measures have been implemented in urban and other tributary basins included in the Everglades Stormwater Program (ESP). Nonetheless, additional measures are necessary to achieve the Everglades water quality goal. The Long-Term Plan contains activities to achieve that goal and to permit the State of Florida and the South Florida Water Management District (District or SFWMD) to fulfill their obligations under both the Everglades Forever Act [EFA; Section 373.4592, Florida Statutes (F.S.)] and the federal Everglades Settlement Agreement (i.e., Settlement Agreement dated July 26, 1991, entered in Case No. 88-1886-Civ-Hoeveler, U.S. District Court for the Southern District of Florida, as modified by the Omnibus Order entered in the case on April 27, 2001). The Long-Term Plan was developed in full recognition of the substantive remaining scientific uncertainties surrounding that objective. It is predicated upon maximizing water quality improvement through an adaptive implementation process.

OVERVIEW OF THE LONG-TERM PLAN

The Long-Term Plan has three primary components:

1. **Pre-2006 Projects:** Structural and operational modifications that can be supported by the current scientific and engineering knowledge base, to be implemented where feasible by December 31, 2006, as well as operation, maintenance, and monitoring of the STAs. The pre-2006 recommended improvements and strategies are considered to be the maximum scientifically defensible steps that had been identified at the time the plan was developed. There is a possibility that these steps will meet a planning target of a long-term, geometric mean total phosphorus (TP) concentration of 10 ppb in discharges from the various basins. However, it is also possible that these improvements and strategies will not, in and of themselves, provide adequate assurance of an ability to consistently meet that objective on a long-term basis. Therefore, the post-2006 strategy is included in the Long-Term Plan, as discussed below.
2. **Process Development and Engineering (PDE):** Process Development and Engineering (PDE) activities have been designed to (1) further understand and optimize water quality performance in existing and proposed facilities; (2) facilitate integration with the Comprehensive Everglades Restoration Plan (CERP); (3) maintain and improve upon the contribution of source controls to overall water quality improvement goals; and (4) investigate ways to accelerate the recovery of previously impacted areas in the EPA.
3. **Post-2006 Strategy:** The post-2006 strategy will include the identification and adaptive implementation of additional water quality improvement measures that may be considered necessary to comply with water quality standards following completion of the pre-2006 activities based on ongoing analysis of the PDE effort. It also comprises implementation of steps identified that are capable of accelerating the recovery of previously impacted areas in

the EPA including final implementation of the hydropattern restoration activities directed by the EFA once water quality standards (including the phosphorus criterion) are achieved.

The Long-Term Plan was developed in recognition that:

> Achieving water quality standards, including the numeric phosphorus criterion (Rule 62-302.540, F.A.C.) will involve an adaptive management approach, whereby the best available information is used to develop and expeditiously implement incremental improvement measures consistent with informed and prudent expenditure of public and private funds.
>
> Continued investigations are necessary to further improve the overall operation and performance of integrated water quality improvement strategies.
>
> Significant performance and economic benefits can be realized by integrating Everglades water quality improvement measures with CERP projects, even to the extent that existing schedules should be reevaluated in some basins and synchronized with CERP project schedules. Modifications to the design and operation of planned CERP projects should be considered.

The October 27, 2003, the Long-Term Plan was submitted to the Florida Department of Environmental Protection (FDEP) in December 2003 as part of the long-term permit application required by the EFA. FDEP's review of the long-term permit application is currently underway. The October 27, 2003 version of the Long-Term Plan is presented on the District's Website at http://www.sfwmd.gov/org/erd/bsfboard/waterquality.pdf. Additional information on the Long-Term Plan including related links, documents, presentations, and photos can be found at http://www.sfwmd.gov/org/erd/longtermplan/index.shtml.

The Basin-Specific Feasibility Studies, which formed the basis for the Long-Term Plan, are documented in the Evaluation of Alternatives for the ECP Basins (Burns & McDonnell, 2002) and the Basin-Specific Feasibility Studies, Everglades Stormwater Program Basins (Brown and Caldwell, 2002). The feasibility studies are also discussed in Chapter 8A of the 2003 and 2004 Everglades Consolidated Reports (ECRs). Documents, presentations, data, and other related information on the Basin-Specific Feasibility Studies can be found on the District's Website at http://www.sfwmd.gov/org/erd/bsfboard/bsfsboard.htm.

STATUS OF PROJECT-LEVEL ACTIVITIES

The District began implementing the Long-Term Plan projects in Fiscal Year 2004 (FY2004). The first annual public meeting was held on February 26, 2004 at the District's headquarters in West Palm Beach, Florida. The purpose of this meeting was to update the public on the status of the projects midway through the first year of implementation and to receive input from the public on proposed modifications to the Long-Term Plan.

Because there is overlap between many of the Long-Term Plan projects and other Everglades restoration efforts by the District, updates for several of the Long-Term Plan projects will appear in other chapters of the *2005 South Florida Environmental Report* (2005 SFER). **Table 8-1** summarizes all of the Long-Term Plan projects, including cross-references to the 2005 SFER – Volume I chapters in which the specific project update appears. An update on the status of project-level activities for eight of the Long-Term Plan projects for FY2004 is summarized below.

Continued Development and Refinement of the DMSTA

The Dynamic Model for Stormwater Treatment Areas (DMSTA) (Walker and Kadlec, 2002) is the tool used to model the future phosphorus performance of the STAs. The DMSTA was used to evaluate components of the Long-Term Plan and will be applied to future enhancements and the interaction between Comprehensive Everglades Restoration Plan (CERP) reservoirs and the STAs. To increase the certainty in the accuracy of the model predictions, the model will be updated and calibrated. Refinements to the DMSTA include calibrating the model using large-scale systems operating in the event-driven mode (e.g., recent STA data) as well as the addition of model compartments, such as a reservoir module, sediment compartment, and phosphorus speciation components. The tasks identified in the Long-Term Plan for FY2004 are being completed by the U.S. Department of the Interior (USDOI) and the U.S. Army Corps of Engineers (USACE) through contracts with Dr. William W. Walker, Jr.

Water Quality Impacts of Reservoirs

The Water Quality Impacts of Reservoirs project was initiated, as recommended in Section 5.3.2., Water Quality Impacts of Reservoirs of the Process Development and Engineering (PDE) component of the Long-Term Plan. Because some of the STAs will receive discharges from CERP reservoirs, the primary objective of this project is to assist CERP's Project Delivery Teams (PDTs) in the acquisition and analysis of calibration data sets for use with a water quality model capable of simulating reservoirs. This project is currently contracted with Burns & McDonnell. The contract was executed on November 10, 2003 and covers a period of 12 months.

There are three major tasks associated with this contract. The first task involved identification of data sites and data acquisition is complete. Thirty-six primary data sites were identified and various types of data were acquired from three water management districts in Florida. These data include the physical characteristics of the water bodies, time series and non-time series hydrologic and hydraulic data, time series water quality data, non-time series biological data, time-series atmospheric data, and cost information. In order to be useful as a calibration data set, the 36 primary data sites were rated as good, fair, and poor based on the data selection criteria developed by the project team. As a result, eight data sites were rated as good and were selected for further analysis. The second major task involves the data analysis for the eight selected data sites; this task is near completion. The final major task is transformation of the data for use in calibration of a reservoir water quality model such as the DMSTA. This task is scheduled to be complete in early FY2005. This project is currently within budget and on schedule.

Update Baseline Data Sets

As recommended in the Long-Term Plan, the analyses presented in the Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-Term Water Quality Goals for the Everglades (Goforth and Piccone, 2001) should be updated no less frequently than once every two years to continually improve the degree of confidence in the projected TP loads in inflows to the treatment areas, or in some instances, discharged directly to the EPA. The Baseline Data report employed available flow and water quality data from 1989–1999; in some basins, little data was available at that time. The first update was initiated in FY2004 and was amended to include the record flow and water quality data through April 30, 2003. A revised ECP base run using the latest version of the South Florida Water Management Model (SFWMM) was also initiated in FY2004 to reflect the latest calibration data for EAA runoff and to incorporate the latest ECP design information. During the remainder of FY2004 and into FY2005, new regression

relationships between the amended historic flow and water quality data will be developed and combined with the results of the ECP base run to develop new 36-year inflow data sets. These data sets can then be used to update the projected TP loads in inflows to the treatment areas or to the EPA. It is anticipated that this analysis will occur in FY2005, consistent with the Long-Term Plan recommendation to provide funding for the inflow data set updates beginning in FY2005 and extending through FY2015 in alternating years.

Basins with Limited Current Data

Water quality performance projections for Everglades restoration efforts depend on understanding water movement and nutrient loadings from multiple watersheds. The projections utilize models that are calibrated from flow and water quality data collected at representative sites throughout the region. After the Everglades Protection Project Conceptual Design (Burns and McDonnell, 1994) was developed, there was an acknowledged uncertainty in the relationship between discharge volumes and total phosphorus from the C-51 West basin. This uncertainty remained when the 2002 Basin-Specific Feasibility Studies for the ECP basins were completed (Burns and McDonnell, 2002). The first basin to be examined under this Long-Term Plan project was the C-51W sub-basin. To better estimate the flow and TP loading and concentrations leaving the C-51W sub-basin, updated flow and TP data from the S-5AE and State Road 7 structures were analyzed and a regression equation was developed. The results of this analysis indicate that the basin's flow-weighted TP mean concentration is approximately 118 ppb, about 36 percent less than the value used in the development of the Long-Term Plan. The net effect of this reduction is a lower estimate of the future TP loads entering STA-1E.

Influence of CERP Projects on Inflow Volumes and Loads

As CERP projects proceed through planning and implementation, the projected impact of these projects on the inflow volumes and loads to the STAs and the EPA receiving water bodies needs to be updated. Of particular interest is the EAA Storage Reservoirs project, which will be linked operationally to one or more of the STAs upon its completion. During preparation of the Basin-Specific Feasibility Studies, very little information was available about the relationship of the EAA storage reservoirs outflows to STA inflows and, therefore, various assumptions were made with the understanding that future updates would be made as more information became available. Because the Phase I EAA storage reservoir has been expedited to the design phase, better information now exists regarding the proposed size, location, and operation of the reservoir which will provide inflows to the STA. As recommended in the Long-Term Plan, estimated inflows to the STAs will be fully redressed following completion of the initial planning, hydrologic analyses, plan selection, and water quality change projections for the Phase I EAA Reservoir project. This first update is scheduled to occur in FY2005. No activities were scheduled for this project in FY2004.

Lake Okeechobee Long-Term Trends

Lake Okeechobee will contribute a significant portion of the water anticipated to be captured and treated in the STAs. A better understanding of the temporal and spatial characteristics of the water leaving the lake is needed for updated STA performance projections. An examination of the water quality and flow from the structures discharging lake water into the EAA (S-351, S-352, and S-354) and ultimately into the STAs is currently being conducted by the District.

Adaptive Implementation

Part 6 of the Long-Term Plan includes a recommendation that a dedicated funding source be established to facilitate the adaptive implementation process and assure that additional steps are expeditiously implemented. It was recommended that the use of this funding be limited to additional enhancements and modifications resulting from the PDE process that could be implemented within the footprints of the ECP STAs or added to CERP projects as a locally preferred option to enhance their water quality performance. The Long-Term Plan includes a recommendation for funding of $36 million distributed as $9.0 million per year in FY2007–FY2010. Although no funds were recommended for this project until FY2007, an opportunity arose in FY2004 to integrate with the expedited Bolles and Cross Canal Improvements project with the goal of improving the ability to provide inter-basin transfer of water among the STAs for more balanced and integrated operations. Excess funds which were not needed for several Long-Term Plan projects were provided to assist with the surveying phase of the Bolles and Cross Canal Improvements project. Additional information on this revision to the Long-Term Plan, including the transfer of funds and the FDEP approval of the revision, is further discussed in the "Revisions to the Long-Term Plan" section of this chapter.

Program Management

During FY2004, program management activities performed by the District and contractors included maintenance of the P3e project schedules, STA operational support, and overall Everglades program coordination. In FY2004, the Operation Plans for STA-1W, STA-2, STA-3/4, STA-5, and STA-6 were updated. The initial Operation Plan for STA-1E was also developed by the District.

REVISIONS TO THE LONG-TERM PLAN

As stated in the 2003 amended EFA, revisions to the Long-Term Plan shall be incorporated through an adaptive management approach including a process development and engineering component to identify and implement incremental optimization measures for further phosphorus reductions. Also, as stated in the amended EFA, revisions to the Long-Term Plan shall be approved by the Florida Department of Environmental Protection.

The Long-Term Plan dated October 27, 2003 includes a proposed process for revisions to the plan. Revisions to the Long-Term Plan are classified as minor or major based upon the following criteria: (1) the magnitude and nature of the proposed revisions; (2) the potential for the proposed revision to have environmental impacts that are significantly different from those previously considered by the FDEP for the project; (3) the potential for the revision to adversely impact the intent and purpose of the Long-Term Plan; and (4) whether the revision requires approval by the District's governing board. As required in Section 1.10.4 of the Long-Term Plan, a description of the revision, whether minor or major, is to be included in the annual Everglades Consolidated Report (currently known as the *2005 South Florida Environmental Report*).

On March 18, 2004, the District submitted via e-mail the first request to the FDEP for a proposed revision to the Long-Term Plan. A description of the proposed Revision 1 to the plan is presented below:

Revision 1 to the Long-Term Plan

Scope: Consistent with the existing Plan:

To facilitate the adaptive implementation process and assure that additional steps are expeditiously implemented, the District is proposing to add a paragraph to Bc88 (Adaptive Implementation, section 6.3.1 page 6-92) describing pre-2006 activities to implement the intent of the interbasin transfer concept.

"Interbasin transfer of water among the STAs for more balanced and integrated operations" (Page 6-3 of the Long-term Plan).

This project will improve interbasin transfer of water among the Hillsboro, North New River and Miami Canal basins, benefiting STA-2 and STA-3/4. Also, this activity is consistent with other concepts of the existing Plan:

Enhance integration with CERP (page 5-1).

Significant technical and economic benefits can be realized by integrating Everglades water quality performance measures with CERP projects, even to the extent that existing schedules should be re-evaluated in some basins and synchronized with CERP project schedules.(page 5-1)

The FY04 activity consists of assisting with the funding of the survey work in advance of design and construction of the Bolles and Cross Canal improvements. The FY05 and FY06 activities will advance the design and possibly expedite the commencement of construction of the canal improvements.

Budget:
$330,000 in FY04
$500,000 in FY05 (estimate)
$500,000 in FY06 (estimate)

On April 15, 2004, the FDEP approved via e-mail the District's first proposed revision to the Long-Term Plan. As part of its review, the FDEP concurred that the revision constituted a minor revision and that the Bolles and Cross Canal improvements would greatly improve the District's ability to integrate the EAA storage reservoir into STA optimization through enhanced ability for cross basin transfer of flows.

CHALLENGES TO ACHIEVING LONG-TERM WATER QUALITY GOALS

Successful implementation of the Long-Term Plan will require integration of numerous research, planning, regulatory, and construction activities, as introduced in Chapter 1 of this volume. The District and the FDEP are committed to achieving these long-term water quality goals. Some of the more significant challenges for these goals include regulatory issues, uncertainties in long-term performance of source control and in regional treatment technologies, and integration with CERP projects.

REGULATORY ISSUES

In July 2003, the State of Florida's Environmental Regulation Commission (ERC) adopted a water quality standard for phosphorus within the Everglades Protection Area that includes:

1. A numeric criterion of 10 ppb for total phosphorus in the EPA.
2. Moderating provisions, which authorize discharge to the EPA where net improvement is provided in impacted areas or where hydropattern restoration benefits clearly outweigh adverse impacts in unimpacted areas.
3. A method for determining achievement of the phosphorus criterion.

In June 2004, an administrative law judge issued a Final Order in favor of the State of Florida supporting the ERC's adopted phosphorus rule. The rule was then submitted to the U.S. Environmental Protection Agency (USEPA) for approval upon resolution of the challenges. The Long-Term Plan being implemented by the District has the planning goal of achieving water quality standards, including the phosphorus criterion in the Everglades Protection Area. During the initial phase of implementation (pre-2016) of the Long-Term Plan, permits issued by the FDEP shall be based on Best Available Phosphorus Reduction Technology, as defined by the EFA, and shall include Technology-Based Effluent Limits consistent with the Long-Term Plan.

In addition, the FDEP must evaluate water quality standards for parameters other than TP for the EPA and EAA canals. As a part of this evaluation, the FDEP is also specifically directed by the EFA to recognize by rulemaking the existing beneficial uses of the EAA conveyance canals. Although the EFA does not set a specific deadline for this rulemaking, it is assumed that it will be completed by December 31, 2006. Other regulatory issues are discussed in Chapter 3 of this volume.

STORMWATER TREATMENT AREA OPTIMIZATION RESEARCH

Chapter 4 of the 2005 SFER – Volume I presents a summary of STA optimization research which occurred in FY2004. While critical research is continuing on STA optimization, the Long-Term Plan includes a process of adaptive implementation to incorporate the best available and scientifically defensible information during implementation of the plan.

SOURCE CONTROL MEASURES

While landowners within the Everglades Agricultural Area as a whole have implemented effective source control BMPs, the Long-Term Plan includes funding for identification of "hot spots" within the EAA and for implementation of source control measures in these locations. The Long-Term Plan also includes funding for identification and implementation of source control measures in other rural (non-ECP) basins and in urban basins. Although source control development and implementation funding was provided in FY2004 as part of the Long-Term Plan, comparatively minimal information is currently known about the technical efficacy and economics of controlling TP loads from these other non-ECP basins.

SYNCHRONIZATION WITH CERP PROJECTS

The majority of Everglades tributary basins contain proposed CERP projects. During FY2004, the District coordinated with members of CERP's Project Delivery Teams in an effort to integrate Long-Term Plan projects with CERP projects, where possible. The potential remains for significant cost savings by integrating some of the Long-Term Plan components with CERP projects. Many of the CERP projects are still in the early planning and design phases. Therefore, uncertainty continues to exist in how CERP projects will influence flows and water quality, as well as their implementation schedules. Continued close coordination is needed between members of the PDTs and staff implementing the Long-Term Plan components to ensure that project goals are met on schedule.

PHOSPHORUS LOADS TO THE EVERGLADES PROTECTION AREA

The Everglades Protection Area is a complex system of marsh areas, canals, levees, and inflow and outflow water control structures covering almost 2.5 million acres. In addition to rainfall inputs, surface water inflows regulated by water control structures from agricultural tributaries, such as the EAA and the C-139 basin, feed the EPA from the north and western boundaries. The EPA also receives surface water inflows originating from Lake Okeechobee to the north and from predominantly urbanized areas to the east. The timing and distribution of the surface inflows from the tributaries to the EPA are based on a complex set of operational decisions that account for natural and environmental system requirements, water supply for urbanized and natural areas, aquifer recharge, and flood control.

Each year, the EPA receives variable amounts of surface water inflows based on the hydrologic variability within the upstream basins. These inflows, regulated according to previously mentioned operational decisions, also contribute a certain amount of TP loading to the EPA system. The TP loads to the EPA for WY2004 are tabulated in **Table 8-3**. Detailed estimates of TP loads by structure are presented in **Table 8-4**. These tables summarize contributions from

Table 8-3. WY2004 total phosphorus (TP) loads to the EPA and other waters.

Source Water	Receiving Water	TP Load (metric tons)	Portion of Surface Inflows	Portion of Total Inflows
Lake Okeechobee	EPA (WCAs)	5.8	5.5%	1.9%
	EAA	40.3	---	---
	STAs	4.5	---	---
	Total from Lake Okeechobee	**50.5**	---	---
Everglades Agricultural Area (EAA)	EPA (WCAs)	22.0	21.1%	7.4%
	Lake Okeechobee	0.1	---	---
	STAs	66.7	---	---
	Holey Land and Rotenberger	1.9	---	---
	Total from EAA	**90.97**	---	---
Stormwater Treatment Areas (STAs)	EPA (WCAs)	38.4	36.9%	12.9%
	Lake Okeechobee	0.0	---	---
	Holey Land and Rotenberger	1.0	---	---
	Total from STAs	**39.3**	---	---
			---	---
Rotenberger	EPA (WCAs)	0.02	0.0%	0.0%
L-8 & C-51W	STAs	1.1	---	---
Acme Basin B	EPA (WCAs)	2.1	2.0%	0.7%
Boynton Farms	EPA (WCAs)	0	0.0%	0.0%
North Springs Improvement District	EPA (WCAs)	0	0.0%	0.0%
North New River Canal Basin	EPA (WCAs)	0.05	0.0%	0.0%
C-11 West Basin	EPA (WCAs)	5.1	4.9%	1.7%
C-11 Basin	EPA (ENP)	2.8	2.7%	0.9%
Feeder Canal Basin	EPA (WCAs)	14.4	13.9%	4.9%
L-28 Canal Basin	EPA (WCAs)	7.0	6.8%	2.4%
C-139 Basin	EPA (WCAs)	6.3	6.0%	2.1%
	STAs	48.6	---	---
	Lake Okeechobee	0.0	---	---
	Total from C-139 Basin	**54.9**	---	---
L-28 Gap Basin	EPA (WCAs)	No data	---	---
Total Surface Inflows	EPA (WCAs)	103.9	100%	35.0%
Atmospheric Deposition	WCA-1 (35 mg/m2/yr	20	---	---
	WCA-1 (35 mg/m2/yr	18.8	---	---
	WCA-1 (25 mg/m2/yr	70.4	---	---
	ENP (20 mg/m2/yr	84.1	---	---
	Total Atmospheric Deposition	**193**	---	65%
Total Load to the EPA	**EPA (WCAs)**	**297**	---	100%
Load from the EPA	STAs	1.4	---	---
	S-34, S-38 & S-39	10.8	---	---
	Total Loads from EPA	**12.2**	---	---

Table 8-4. WY2004 summary of flow and total phosphorus by structure.

Into WCA1

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
G300 & G301	17	3104	148
from EAA		*2629*	
from Lake O		*16*	
from East Beach		*448*	
from inflow Basin		*11*	
G251 (from STA-1W)	55	3000	44
G310 (from STA1W)	243	14061	47
ACME1 (from Basin B)	10	890	72
ACME2 (from Basin B)	10	1227	101
Total	**335**	**22282**	**54**

From WCA1

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S10A	9	665	57
S10C	8	436	42
S10D	59	5292	72
S10E	0	0	n/a
S39	136	4201	25
G300	1	110	89
G301	30	1463	39
Total	**243**	**12167**	**41**

Into WCA2

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
G335 (from STA-2	285	5031	14
S7	156	8578	44
From EAA		*7189*	
from Lake O		*1389*	
S10A (from WCA1)	9	665	57
S10C (from WCA1)	8	436	42
S10D (from WCA1)	59	5292	72
S10E (from WCA1)	0	0	n/a
N. Springs Improv. District	0	0	n/a
Total	**517**	**20002**	**31**

From WCA2

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S7	2	80	32
S11A	47	1003	17
S11B	108	1983	15
S11C	122	4504	30
S38	144	2331	13
S34	151	4261	23
Total	**574**	**14162**	**20**

Into WCA3

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S140 (from L28 Canal)	136	7018	62
S190 (from Feeder Canal)	118	14410	99
L3BRS (G88+G155) (from C139)	11	2949	215
STA6	36	515	12
S8	350	30862	71
From EAA		*10455*	
From Lake O		*4355*	
From C-139		*3156*	
From STA-5		*12881*	
From Rotenberger		*14*	
S150 (from EAA)	8	309	33
G204 (from Holey Land	0	0	n/a
G404 & G357	72	3769	42
From EAA		*796*	
From C-139		*172*	
From STA-5		*2791*	
from Rotenberger		*10*	
S11A (from WCA2)	47	1003	17
S11B (from WCA2)	108	1983	15
S11C (from WVA2)	122	4504	30
G123 (from N. New River)	2	46	16
S9 (from C-11 West)	150	3387	18
S9A (from C-11 West)	108	1735	13
Total	**1268**	**72490**	**46**

From WCA3

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S150	0	0	n/a
S8	0	0	n/a
G204	0	0	n/a
S31	32	No data	No data
S337	2	No data	No data
S343A	6	68	9
S343B	8	90	9
S344	4	47	9
S12A	103	990	8
S12B	98	782	6
S12C	302	2767	7
S12D	335	4521	11
S333	175	2328	11
S14	0	0	n/a
Total	**1031**	**11593**	**9**

Into Everglades National Park

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S12A (from WCA3)	103	990	8
S12B (from WCA3)	98	782	6
S12C (from WCA3)	302	2767	7
S12D (from WCA3)	335	4521	11
S333 (from WCA3)	175	2328	11
S14 (from WCA3)	0	0	n/a
S174 (from L31W)	5	42	6
S332D (from L-31W)	128	908	6
S-18C (from C-111 Canal)	159	1845	9
Total	**1305**	**14183**	**9**

From ENP

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S334	96	1311	11
S197	3	13	3
Total	**99**	**1324**	**11**

FWMC = flow-weighted mean concentration

all connecting tributaries to the EPA: Lake Okeechobee, the EAA, the C-139 basin, other agricultural and urbanized areas, and the STAs. In some cases, surface water inflows represent a mixture of water from several sources as the water passes from one area to another before finally arriving in the EPA. For example, water discharged from Lake Okeechobee can pass through the EAA and then through an STA before arriving in the EPA. Similarly, runoff from the C-139 basin can pass through STA-5 and then into the EAA before ultimately arriving in the EPA.

It is also recognized that a certain amount of TP loading to the EPA emanates from atmospheric deposition. **Table 8-3** depicts a long-term average range of atmospheric deposition of TP between 107 and 143 metric tons as the total contribution to the Water Conservation Areas (WCAs). This range is based on data obtained from long-term monitoring that was evaluated by the District, as reported in Redfield (2002).

Comparison of WY2004 Phosphorus Loads to 1979–1988 Baseline

The following section provides an overview of phosphorus loading into the EPA for WY2004. The period from October 1978 through September 1988 has been identified as a comparative baseline period (known as the 1979–1988 baseline period) for various planning purposes, including the Surface Water Improvement and Management Act (SWIM) Plan for the Everglades (SFWMD, 1992a, 1992b, and 1992c), the design of the Everglades Construction Project, the federal Settlement Agreement, and the Everglades Forever Act, as amended. During this 10-year period, annual phosphorus loads in surface inflows to the EPA ranged from approximately 100 metric tons to over 350 metric tons, with an average of 270 metric tons (1992 Everglades SWIM Plan). Included in this 270-metric ton annual average were approximately 205 metric tons to the WCAs from the EAA, Lake Okeechobee, and the L-8 and C-51W basins through the S-5A, S-6, S-7, S-150, and S-8 structures. This 205-metric ton annual average for this 10-year baseline period was the basis of design for the four original STAs of the Settlement Agreement. During the 1979–1988 baseline period, phosphorus loads in surface inflows to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) ranged from approximately 40 metric tons to over 150 metric tons per year, with a 10-year average of about 110 metric tons per year (SFWMD, 1992a and 1992b). Included in this 110-metric ton annual average were approximately 105 metric tons from the EAA, Lake Okeechobee, and the L-8 and C-51W basins through the S-5A and S-6 pump stations. This 105-metric ton annual average for the 10-year baseline period to the Refuge was the basis of design for the original STA-1 and STA-2 of the Settlement Agreement.

Appendix C of the Settlement Agreement identifies several assumptions which, when combined in series, are expected to yield approximately an 80-percent reduction of phosphorus loads from the EAA to the WCAs. These assumptions are as follows:

1. The EAA BMPs will achieve 25-percent load reduction,
2. Water retention due to implementation of EAA BMPs will equal 20-percent of the 10-year base flow,
3. The STAs will achieve 70-percent load reduction, and
4. A further load reduction of 6 percent was assumed by conversion of existing agricultural land to STAs.

For modeling purposes associated with Appendix C, the historic load and flow from each basin were reduced to account for low-flow water-supply deliveries from Lake Okeechobee, i.e., canal

flows that do not impact WCA marshes. The STAs were then sized to achieve a long-term annual flow-weighted mean concentration of 50 ppb at each inflow point. Accomplishment of the 50-ppb objective was assumed to provide the load reduction of approximately 80 percent from the EAA into the EPA. Using the loads that occurred during the baseline period (1979–1988) and the Appendix C assumptions, the anticipated 10-year average load equating to this 80-percent reduction is approximately 40.2 metric tons from the EAA to the WCAs.

Similarly, the Settlement Agreement also envisions an approximate 85-percent reduction of phosphorus loads from the EAA to the Refuge, if the STAs achieve a long-term annual flow-weighted mean concentration of 50 ppb. Using the loads that occurred during the baseline period (1979–1988) and the Appendix C assumptions, the anticipated 10-year average load equating to this 85-percent reduction is approximately 15.5 metric tons from the EAA to the Refuge.

In 2002, the Technical Oversight Committee (TOC) established, pursuant to the Settlement Agreement, a methodology developed by Walker (1996) for reviewing the load reductions based on annual phosphorus concentrations of water entering the WCAs and the Refuge. This methodology assumes compliance with the reduction requirements unless the annual phosphorus inflow concentration to the WCAs (and the Refuge) from the EAA and bypassed flows is greater than 76 ppb in any water year or is greater than 50 ppb in three or more consecutive water years (Walker, 1996). Compliance will not be tested in water years when the EAA adjusted annual rainfall is above 63.8 inches, as defined in the SFWMD Rule 40E-63 (http://fac.dos.state.fl.us/faconline/chapter40.pdf). Compliance will also not be tested in water years when the EAA adjusted rainfall is below 35.1 inches, if sufficient water is not available to maintain wet conditions in the STAs. The following discussion of the water year loads does not substitute for the compliance review activities of the TOC but is simply a public presentation of relevant data as requested by the TOC.

Phosphorus loads to the EPA during WY2004 were significantly lower than the 1979–1988 baseline period. As shown in **Tables 8-3** and **8-4**, loads to the EPA totaled approximately 104 metric tons, with a flow-weighted mean concentration of 41 ppb. This is an almost 25-percent reduction from the previous year (136 metric tons). It should be recognized that this entire load did not come from the EAA. Phosphorus loads to the WCAs from the EAA were calculated as:

1. A proportion of STA-1W and STA-2 discharges, adjusted to reflect contributions from non-EAA sources [STA-1W (from EAA: 82 percent), STA-2 (from EAA: 97 percent)],
2. STA-6 discharges, and
3. Direct EAA discharges from the S-7, S-8, S-150, G-300, and G-301 structures.

Phosphorus loads to the WCAs from the EAA during WY2004 totaled about 41.5 metric tons, slightly lower than the previous year. The three-year average load to the WCAs from the EAA is 38 metric tons, which is slightly lower than the expected 10-yr average of 40.2 metric tons. This relatively low average load is significant considering that STA-1E and STA-3/4 were not fully operational during WY2004. The flow-weighted mean phosphorus concentration entering the WCAs from the EAA, STA-1W, STA-2, STA-3/4, STA-6, and bypass flows during WY2004 was approximately 42 ppb, which is below the annual maximum of 76 ppb established by the TOC methodology.

Phosphorus loads from all sources to the Refuge during WY2004 totaled approximately 22.3 metric tons, which is an almost 50-percent reduction from the previous year (43.4 metric tons). Approximately 1.5 metric tons were recirculated into STA-1W from the Refuge during a

two-week flow test, bringing the net load to the Refuge to about 21 metric tons. The phosphorus load to the Refuge from the EAA during WY2004 was approximately 17.1 metric tons, including more than 3 metric tons that were directly bypassed into the Refuge because insufficient hydraulic capacity existed in the inflow structure to STA-1W; some of this load could have been captured and treated in STA-1E had it been in flow-through operation. The three-year average of loads from the EAA to the Refuge was 15.4 metric tons, slightly below the anticipated 10-year average load of 15.5 metric tons. The flow-weighted mean phosphorus concentration for WY2004 from STA-1W into the Refuge was 47 ppb; the 10-year flow-weighted mean phosphorus concentration for WY2004 from STA-1W into the Refuge was 38 ppb, 24-percent lower than the 50-ppb objective in the Settlement Agreement. The flow-weighted mean phosphorus concentration entering the Refuge from the EAA, STA-1W, and bypass flows during WY2004 was approximately 52 ppb, which is below the annual maximum of 76 ppb established by the TOC methodology and slightly lower than the 54 ppb observed during the previous water year. If STA-1E had been in flow-through operation during this period, then the total TP load and concentration from the EAA to the Refuge would have been reduced.

CONCLUSIONS

The Long-Term Plan is predicated upon maximizing water quality improvement through an adaptive implementation process in which:

All scientifically defensible steps are taken at the earliest achievable dates and in full recognition of the timeline established in the EFA.

Focused efforts are directed to improving the scientific and technical basis for additional steps, leading to incremental implementation of those steps as soon as their needs are confirmed.

The synergy between this effort and other regional efforts, particularly CERP, is recognized and maximum benefit realized from full integration with those efforts.

Existing and proposed treatment facilities are operated, maintained, and monitored to maximize their treatment effectiveness.

Steps are being taken to accelerate the recovery of previously impacted areas in the EPA, including completion of the hydropattern restoration goals of the EFA.

The District is actively implementing the numerous projects of the Long-Term Plan, as required by the EFA, and is following a process of adaptive implementation consistent with the above-mentioned goals and objectives.

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